Prioritized Technology: RPS Orbital Radioisotope Thermoelectric Generator - Next Gen RTG

Technical Goal

- A 2016 study conducted with the mission community identified impediments to using the MMRTG to support science missions and needs of the Next RTG.
  - The two major concerns of the community include the higher MMRTG degradation rate and the power of the MMRTG.
  - The MMRTG provides approximately 110 Watts, which maybe too low of a power point to best benefit PSD missions.
  - Integration of multiple hundred watt units is possible but increases the mass, increases integration complexity, increased overall mission cost, and increases the use of Pu-238.

- The next step on our roadmap after eMMRTG is to provide a modular, higher power system.
- A 2017 study was conducted. This study is being used to determine the top level requirements of the Next Gen system. These requirements will be used to provide the lower level requirements for the thermoelectrics.
  - Considerations will be given to efficiency and prior investments before an investment strategy is determined for thermoelectric technology maturation leading to a new system development by the Department of Energy.

Mission Applications

- A higher power system, in the range of 400 – 500 Watts is more desirable to the future PSD missions for flyby and orbit. This is consistent with the results from the 2014 Nuclear Power Assessment Study conducted by the RPS program.

Technical Status - SOA

- The current SOA for RPS is the MMRTG (6% efficiency), which was designed to multi-mission requirements
- MMRTG Engineering Unit successfully tested to the multi-mission levels
- MMRTG F1 was proto-flight tested to the MSL requirements
- Investments made in the thermoelectric (TE) technology area have lead to the development of materials that have a higher efficiency (9-15% efficiency) and a lower degradation rate.

	Parameter	MMRTG	eMMRTG	Next Gen
Performance	P_0 - BOL (We) [(1)]	110	148	590.2
	Efficiency - $P_0/Q*100$ (%)	6.00%	8.00%	10-14%
	Specific Power - P_0/m (We/Kg)	2.44	3.29	9.3
	Q - BOL (Wth) [(4, 5)]	2000	2000	4000
	Average annual power degradation, r (%/yr)	4.8	2.5 [(3)]	1.9 [(3)]
	P_{EODL} - $P=P_0*e^{-rt}$ [(2)] (We)	NA	80	427.3
	Design Life, t (yrs)	17	17	17
	Planetary Atmospheres (Y/N)	Y	Y	N
Physical Characterisitics	Mass - m (kg)	45	45	63.7
	Dimensions, d x l (m)	0.65 x 0.69	0.65 x 0.69	0.71 x 1.0

Definitions

Beginning of Life (BOL) is defined as time of fueling

Beginning of Mission (BOM) is defined as Launch, and can be as long as 3 years after BOL

End of Design Life (EODL) is 17 years after BOL

Heat Source

Step-2 GPHS, estimated at 244-256 W_t at BOL will be used for this study

Development Cost and Schedule